the character of the reaction, or by altering both. Cases of this kind are cited from his own researches and those of KLEBS, ROTHERT, VÖCHTING, and others. This variation in sensitiveness has a parallel in that of other physiological characters, as, for example, the behavior of aerobes toward oxgyen, luminescence, pigment-formation, etc. The specific effect of acids and alkalies is likened to the effects of H^+ and OH^- ions on various functions. Other observers, notably SHIBATA, have shown similar chemotactic sensitiveness of spermatozoids to both anions and cathions.

The author points out "interesting and far-reaching analogies" between the *chemischer Sinn* of bacteria and the corresponding *Geschmackssinn* of man, and suggests that further investigations may find these phenomena more complicated than they now appear.—C. R. B.

Camptotrophism and geotrophism.—Two new terms are added to the vocabulary of irritable phenomena, and some interesting reactions described by BÜCHER.[25] It appears that when a shoot capable of growth is forcibly bent, it reacts to the tensions thereby set up by thickening the walls and reducing the cell diameter in the mechanical tissues (collenchyma, bast, wood) on the convex side, and conversely, forming thinner walls and larger cells on the concave side. This reaction is due to *Kamptotrophismus*, being interpreted as belonging to the same category as WIESNER's heterotrophisms. In like manner when a similar shoot, geotropically sensitive, is fastened in the horizontal position and prevented from responding to gravity, anatomical changes of the same kind ensue, which BÜCHER ascribes to geotrophism. It is unfortunate that the new term is so like the well-established geotropism, with which it will be difficult to prevent confusion, even in English speech.

Simple strain, in the normal position, as BALL showed, does not effect such anatomical changes; but both pressure and traction are effective in the phenomena referred to. The presentation time varies from 24 to 48 hours and the reaction time in Ricinus and Phaseolus is about 3 days. Forcible curvature and restrained geotropic response combined give a summation effect; opposed, one usually prevails strikingly over the other. In Ricinus the geotrophic, in Abutilon and Euphorbia the camptotrophic response dominates. A similar reaction was found in heliotropic stems; analogously, heliotrophism may be predicated. In the excentric growth of the lateral branches of trees there are special reactions which affect the activity of the cambium and its differentiation, but geotrophism is restricted to young parts. Various observers have shown that there are also other causes for heterotrophism.—C. R. B.

Life-history of cotton.—BALLS[26] has studied the life-history of Gossypium from floral development to the early stages of the embryo. Aborted anthers are

[25] BÜCHER, H., Anatomische Veränderungen bei gewaltsamer Krümmung und geotropischer Induktion. Jahrb. Wiss. Bot. **43**:271–360. *figs. 40.* 1906.

[26] BALLS, W. L., The sexuality of cotton. Reprint from Yearbook of the Khedivial Agric. Soc. Cairo. 1905. pp. 26. *pls. 9.*

common, the failure occurring either directly after synapsis, the chromatin thread not being segmented into chromosomes, or after tetrad formation, the spores aborting. The microsporangiate archesporium consists of a hypodermal plate of cells (two cells in transverse section and six in longitudinal). In connection with the reduction division, 20 chromosomes were counted as the gametophyte number; and this was checked up by an approximate count of 40 in certain nuclear divisions of the embryo. The solitary megaspore mother cell is differentiated beneath a heavy development of nucellar tissue (about 12 layers). One of the surprising results is that the functioning megaspore of the linear tetrad is the micropylar one. The antipodal cells are evanescent, and the fusion of the polar nuclei is somewhat tardy. Double fertilization was observed very distinctly. In the development of the embryo no suspensor was discovered, and before the segmentation of the fertilized egg about 100 free, parietally placed, endosperm nuclei have appeared. Later there is endosperm wall-formation, and in the later stages of the embryo it is imbedded in a delicate endosperm tissue. Perhaps the most interesting data are those in reference to the time-relations of these events, the rate of development being unusually high. Flowers hand-pollinated at 10:00 A. M. showed fertilized eggs in the afternoon of the following day. The interval between megaspore-formation and the completed sac (fertilization stage) is three days. About 60 hours after fertilization ($3\frac{1}{2}$ days after pollination) the egg segments, and in about a week after pollination the embryo consists of "hundreds of cells."—J. M. C.

Pteridosperms and angiosperms.—OLIVER has published the substance of a lecture delivered before the Botanical Club of Cambridge University[27] and illustrated it by a scheme of the occurrence of vascular plants in geological time, modified from E. W. BERRY. It discusses the bearing of recent investigations of the pteridosperms and cycads on the origin of seed-plants. Attention is called to the fact that the appearance of the Cycadophyta is geologically synchronous with the disappearance of the pteridosperms, and that the former perpetuate in many respects, especially in the cycadeoidean forms recently described by WIELAND, the fern-like characters of the latter. Just as the incoming of the Cycadophyta marks the end of the reign of the pteridospermic gymnosperms, so the appearance of the angiosperms in the Cretaceous and Tertiary marks the waning of the Cycadophyta. The author calls attention to the angiospermoid protection of the exalbuminous seeds of Cycadeoidea by the sterile scales of the inflorescence. He further emphasizes the resemblance of the bisporangiate inflorescence with its perianth-like envelops in Cycadeoidea with the typical angiospermous flower, since the parts occur in the same order, namely, perianth, microsporophylls, and, uppermost of all, the megasporophylls. He suggests that possibly the Cycadophyta may be appropriately divided into two series, the Gymnocycads and the Angiocycads, the former the ancestors of the living cycads and the latter consti-

[27] OLIVER, F. W., Pteridosperms and angiosperms. New Phytologist 5:232–242. 1906.